Prevalence of Late Amputations During the Current Conflicts in Afghanistan and Iraq

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ABSTRACT During the current conflicts, over 950 soldiers have sustained a combat-related amputation. The majority of these are acute, but an unknown number are performed months to years after the initial injury. The goal of this study is to determine the prevalence of late amputations in our combat wounded. Electronic medical records and radiographs of all soldiers who had a combat-related, lower extremity injury that resulted in amputation were reviewed to confirm demographic, injury, and amputation information. Time to amputation was defined as a late amputation when it occurred more than 12 weeks following the date of injury. There were 348 major limb amputees that met inclusion criteria. Fifty-three (15.2%) amputees had a late amputation (range = 12 wk–5.5 yr). While the majority of combat-related amputations occur acutely, more than 15% occur late. This study demonstrates that further research is needed to identify predictive factors and outcomes of the late amputation.

INTRODUCTION

Many service members have sustained a combat-related amputation and countless more have undergone complex limb reconstruction for severe extremity trauma during the current conflicts. Whereas the majority of these amputations are performed acutely, many are performed months or years after the initial injury.[1] Stansbury et al. reported a 5% rate of late amputations during the current conflicts in Iraq and Afghanistan, although no clear time frame was provided.[1] As the current conflicts continue and patients undergoing limb salvage enter rehabilitation, the number of nonacute amputations continues to increase. Furthermore, several providers (J.R.H., K.L.K., and J.R.F.) have noticed an increase in service members requesting a late amputation for injuries not considered limb threatening (not limb salvage). The purpose of this study is to determine the prevalence of late amputations in our combat wounded.

METHODS

This study was conducted under a protocol reviewed and approved by our institutional review board. The Military Amputee Database maintained at Walter Reed Army Medical Center was used to identify active duty service members who had a combat-related, lower extremity injury resulting in amputation between October 1, 2001 and June 1, 2006. We included all identified service members that received a lower extremity amputation proximal to the tibiotalar joint; partial foot amputations were excluded. Their electronic medical records and radiographs were reviewed to confirm demographic, injury, and amputation information. The following data were extracted for analysis: time from injury to amputation, level of amputation, age at time of injury, and military rank/pay grade. Amputation levels were consolidated into the following categories: multiple (involving more than one lower extremity), above knee (includes hip disarticulation and knee disarticulation), transtibial, and Syme. Rank/pay grades were grouped into three categories: junior enlisted (E1–E4), senior enlisted (E5–E9), and officers (W1–O8).

There is not a consensus definition for "delayed" or "late" amputation. Authors' definitions of late amputation range from 24 hours to more than a year following injury.[2–6] The Lower Extremity Assessment Project (LEAP) study group compared patients who had an amputation performed at four time intervals; within 24 hours of injury, between 24 hours after injury and hospital discharge, between first hospitalization and 3 months after injury, and greater than 3 months after injury. A statistical comparison of outcomes between groups revealed that patients who had an amputation performed 3 months after injury had significantly worse outcomes at 2 years.[2] We utilized this 3-month time point to define late amputations in our study because it resulted in different outcomes in the LEAP study and it allows adequate time for interventions aimed at limb salvage.

Statistical analyses were performed with SAS 9.1 (Cary, North Carolina) to assess for differences across groups. Continuous variables were compared using the Wilcoxon test for nonparametric data, and Student's *t*-test for parametric data. Dichotomous variables were compared using the χ^2 test or Fisher's exact test, as appropriate. All reported *p*-values are two-tailed, with $\alpha \leq 0.05$ representing statistical significance.

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RESULTS

There were 348 lower extremity amputees that had a combat-related, lower extremity injury during the period reviewed that resulted in lower extremity amputation proximal to the tibiotalar joint. Fifty-three (15.2%) amputees had a late amputation (range = 12 wk to 5.5 yr, mean = 1.4 yr, median = 1.1 yr). As seen in Figure 1, below knee amputations make up the largest proportion of both early and late amputations. The time between injury and amputation is shown in Table I. The majority of amputations occurred more than 12 months following injury, nine (17%) of which were beyond 24 months. The age of service members receiving an acute amputation (range = 18–46, mean 25.5, median = 24) and those with a late amputation (range = 19–38, mean 25.5, median = 25) were not statistically different ($p = 0.47$). Whereas officers made up a small portion of the overall amputee population, they made up a significantly higher proportion of late amputees (17%) than early amputees (6.4%) ($p < 0.05$) (Table II).

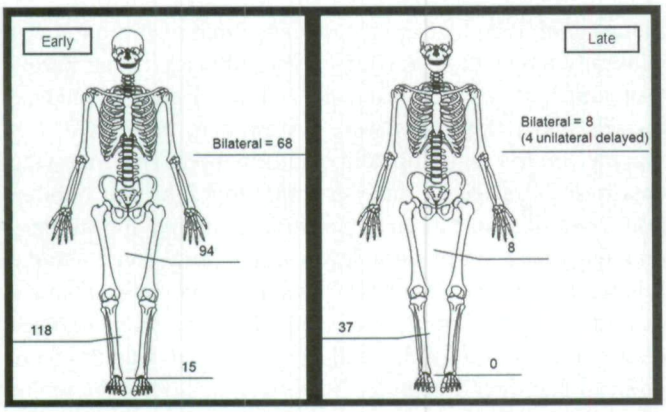

FIGURE 1. Distribution of early versus late amputations. (*Of those included in the bilateral late amputation group (8), 4 had bilateral amputations performed more than 3 months after their injury and 4 had an acute amputation on one lower extremity and a late amputation on the other.)

TABLE I. Time Between Injury and Late Amputation

Time to Amputation	Amputees, *N* (%)
3–6 months	8 (15%)
6–12 months	17 (32%)
12–24 months	19 (36%)
After 24 months	9 (17%)

TABLE II. Percentage of Amputees Based on Rank

Early	295
Enlisted	166 (56.3%)
Officer	19 (6.4%)
Senior Enlisted	110 (37.3%)
Late	53
Enlisted	22 (41.5%)
Officer	9 (17.0%)
Senior Enlisted	22 (41.5%)

DISCUSSION

Whereas the majority of combat-related amputations occurred within the first 3 months following injury, more than 15% were performed greater than 3 months after injury. This rate is significantly higher than the 5% late amputation rate reported previously during the current conflicts.[1] The reasons behind this increase, although not investigated in this study, are likely multifactorial. The most obvious reason is that as more time elapses from the service member's date of injury, additional complications arise such as deep infection, fracture nonunion, or persistent limb pain. These are relatively common complications in the treatment of complex musculoskeletal injuries and can lead to significant challenges in treatment.[4–7]

In one of the most comprehensive prospective studies in the civilian literature evaluating outcomes of complex lower extremity injuries, the LEAP study group had a 3.9% late amputation rate when followed for 2 years, where late was defined as occurring after the initial hospitalization.[6] Other studies report delayed or late amputation rates between 9 and 40% of attempted limb salvage for severe lower extremity injuries.[4,6,8–11] However, it must be emphasized that although many patients in these studies are similar, our patient population consists of those with many types of battlefield injuries. Making the assumption that these are all failed limb salvage patients is flawed because some of our patients had less severe injuries that would not have met LEAP study inclusion criteria. An in depth collaborative investigation is currently underway to investigate the specific injuries and outcomes related to late amputation during the current conflicts.

At both 2-year[2] and 7-year[12] follow-up, the LEAP study group showed no difference in functional outcomes between limb salvage and primary amputation for severe lower extremity injuries. The study group also concluded that emphasis needs to be given to postacute care services that address secondary conditions that may inhibit or delay optimal recovery.[13] The military recognized the importance of postacute care services early and established the United States Armed Forces Amputee Patient Care Program. Under this program, centralized institutions for amputee care at Walter Reed Medical Center, Brooke Army Medical Center, and Naval Medical Center San Diego were created where complex limb reconstruction patients rehabilitate side by side with amputees. At these state-of-the-art centers, centralized teams of surgeons, physiatrists, physical therapists, prosthetists, nurses, peer mentors, and behavioral medicine specialists work to progress the injured soldier from wound closure to reintegration within civilian life or return to active duty, dependent on the soldier's goals.[14] The success with which many amputees are returning to function may be another factor leading some service members undergoing complex limb reconstruction to request an amputation.

In the current study we found no difference in patient age between acute versus late amputees. However, we demonstrated

that officers comprise a higher proportion of the late amputation group compared to those with early amputations ($p < 0.05$). This relative increase may be explained by the fact that officers with severe lower extremity injuries requiring amputations are five times more likely to return to duty (35.3%) than junior enlisted (7%) during the current conflicts ($p < 0.0001$).[15] It has been proposed that officers have a greater ability to control their work environment, which may lead to more returning to duty when compared to junior enlisted.[15] By remaining on active duty, a higher percentage of officers maintain access to providers (orthopedic surgeons and prosthetists) and state-of-the-art amputee rehabilitation services. The easier transition back to active duty and prolonged access to care may ultimately increase their request for a late amputation to treat a chronically painful or dysfunctional lower extremity. A study is underway at our institutions (Brooke Army Medical Center and Walter Reed Army Medical Center) to determine whether a higher percentage of officers remain on active duty after severe lower extremity injuries with limb retention, as they have been shown to do after amputations.

This study has several limitations. First, this is a retrospective analysis, which retains the shortcomings inherent to such studies. Second, although it identifies the prevalence of late amputations in our combat wounded, we did not seek to determine the factors surrounding the decision for undergoing late amputation in our study population during this investigation. Finally, this study is a single snapshot of an ongoing conflict, and as time continues to pass, the prevalence of late amputations in our combat wounded will likely rise.

This study demonstrates that late amputations in our combat wounded are much more prevalent than previously reported. Although the majority of combat-related amputations occur acutely, more than 15% are performed greater than 3 months after injury. This study demonstrates the need for further research to identify predictive factors and effectiveness of the "late amputation." To this end, we have established the Late Amputation Study Team (LAST), which is a multicenter, multidisciplinary team attempting to determine whether late amputation does improve quality of life for injured service members.

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